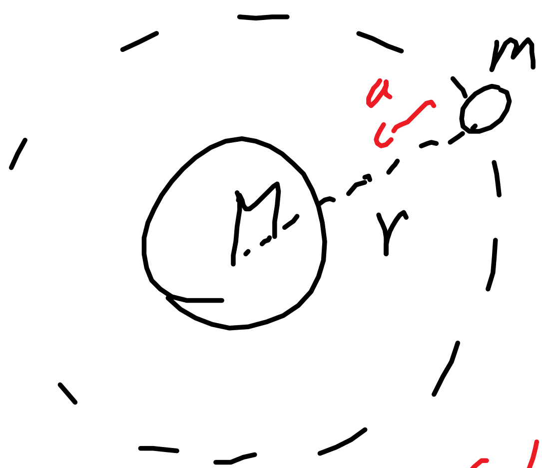
Wednesday, January 04, 2017 10:15 AM

Gravitational Energy Handout
review orbits, gravitational energy
next class - total energy, escape velocity



$$a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

$$a = g = \frac{GM}{r^2}$$

Orbits $$\frac{v^2}{r} = \frac{4\pi^2 r}{T^2} = \frac{GM}{r^2}$$

$$F_g = \frac{GMm}{r^2} \qquad \Delta E_g = W_g = Fd$$

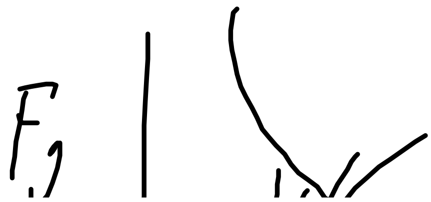
↑ if F is constant

near Earth

$$\Delta E_g = mg\Delta h$$

$$E_g = mgh$$

far from Earth



area = $W_g = \Delta E_g$

magic of calculus

$$E_g = -\frac{GMm}{r}$$ relative to 0 at $r \to \infty$

$$\Delta E_g = -GMm\left(\frac{1}{r_f} - \frac{1}{r_i}\right)$$

↑ can't set lowest point as $E_g = 0$

Homework
question on the board and
handout Q1-9
quiz next Thursday Jan 12

eg.
You want to launch a rocket into orbit around the Earth. If the rocket is 2.00 x 10^3 kg is to be in an orbit 3.59 x 10^7 m away (geostationary satellite) from the surface of the Earth. Determine

a) initial gravitational energy
b) final gravitational energy
c) minimum work done by the engines to get to that height(ignore air resistance)
d) orbital speed

e) minimum total energy required (ignore air resistance)
f) if half of the minimum total energy required is dissipated as heat by the atmosphere, what is the total energy required?
g) How fast do you have to hit a baseball to send it into deep space? (ignore air resistance) Earth's mass=$5.98x10^{24}$kg radius $6.38x\ 10^{6}$m